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(21) International Application Number: PCT/US97/18755 (22) International Filing Date: 14 October 1997 (14.10.97) (63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application US Not furnished (CIP) Filed on Not furnished (71) Applicant (for all designated States except US): ELO TOUCH-SYSTEMS, INC. [US/US]; 41752 Christy Street, Fremont, CA 94538 (US). (72) Inventor; and (75) Inventor/Applicant (for US only): PHARES, Robert [US/US]; 10726 Bell Valley Drive, Knoxville, TN 37922 (US). (74) Agents: PITTS, Robert, E. et al.; Pitts & Brittan, P.C., P.O. Box 51295, Knoxville, TN 37950-1295 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: RESISTIVE TOUCHSCREEN HAVING MULTIPLE SELECTABLE REGIONS FOR PRESSURE DISCRIMINATION		
(57) Abstract <p>A resistive two sheet touchscreen that provides discrimination between objects touching the surface thereof. This is achieved by subdividing one sheet into a selected number of separated portions (50A, 50B, 52A, 52B) of selected configuration. Each of these portions is connected through a switch apparatus to circuitry for evaluating a signal on the separated portions corresponding to the position of touch. This switch can be utilized to deactivate any selected portion (50A, 50B) so that an object contacting this portion provides no signal to the circuitry. Any active portion that remains connected to the circuitry provides position information as with any touchscreen.</p>		

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DescriptionRESISTIVE TOUCHSCREEN HAVING MULTIPLE
SELECTABLE REGIONS FOR PRESSURE DISCRIMINATIONTechnical Field

The present invention relates generally to devices for providing information as to a location of a point in a two-directional array of information, and more particularly to an improved resistive touchscreen that permits a selection of areas of activation of the touchscreen whereby pressure discrimination between areas of touch against the touchscreen can be achieved.

Background Art

Many types of devices have been developed to provide information as to a location within a two-directional array of information. One simple device is a "touchscreen" having a pair of overlaid electrically conductive sheets that are subdivided so as to form a multiplicity of switches. With such a device, the touch of one of the switches causes some activation that is related to the position of the touched switch. Within each switch area, there is no discrimination of the actual point of touch.

More complex devices provide true information as to a location in a two-dimensional array of information. Such devices have been designated the terminology "touch-screens". Within this general designation, there are a multitude of types of devices for providing the positional information. Generally most fall within the category of "resistive" touchscreens where at least one of a pair of closely overlaid electrically conductives has a substantially uniform resistivity throughout. In one class of resistive touchscreens, both of the sheets have this resistivity characteristic and each sheet is sequentially electrically energized to have a locus of equipotential points, or equipotential lines on the resistive surface such that the lines in one layer are straight, and substantially orthogonal to those in the other. Where only one sheet is resistive, the equipotential lines are created by sequentially applying orthogonal voltages to edges of the resistive layer. In the single-layer resistive touchscreens, the second sheet is conductive and is separated from the resistive layer so that the conductive sheet has voltages thereon

only when it is touched to the resistive layer. These voltages provide the two coordinates for ascertaining the position of the contact.

5 Variations on resistive touchscreens have also included devices which added one or more separate non-position discriminating switches outside the viewable area of the touchscreen which would normally be associated with the video display viewed through the touchscreen or
10 with the main target area of the system, in a non-video based application. Also, it is possible to greatly enlarge the sensitive area of the touchscreen such that additional target areas, typically associated with non-position
15 discriminating switches, are defined outside the video display or main target viewing area, with the additional target area being defined for the user by graphics printed or embossed on the outer surface of the top conductive sheet,
20 or by printed graphics viewed through the touchscreen. While these target areas are
inherently position discriminating by virtue of being composed of a region of the touchscreen, their association with some specific system
25 function, performed by system software, is a one-to-one association that causes the

indicated function to be performed regardless of the specific location touched within the target area. Thus, these additional target areas are not intended for, and are not capable of, position discrimination

It is normally desirable to prevent inadvertent touching of the two sheets that might occur because of gravity, curvature of the device, atmospheric conditions, etc.

Toward this end it is conventional to separate the two sheets with small dots or islands of insulative material. These can be applied to the opposed faces of either or both of the layers. Then, because there has been a desire to differentiate between the size of the object touching the touchscreen, or to create a minimum activation force, specific spacing requirements have been applied for these islands of insulative material.

Several United States patents discuss the touchscreens of the prior art, and especially the specific spacing of islands of insulative material. Typical of such touchscreens are described in U. S. Patents: 3,911,215 issued to G. S. Hurst et al on October 7, 1975; 4,220,815 issued to W. A. Gibson et al on

September 1, 1980; 4,661,655 issued to W. A. Gibson et al on April 28, 1987; 4,731,508 issued to W. A. Gibson et al on March 15, 1988; 4,797,514 issued to J. E. Talmage, Jr. et al on June 10, 1989; 4,822,957 issued to J. E. Talmage, Jr. on April 18, 1989; 4,801,773 issued to M. Mizuguchi et al on January 31, 1989; and 5,220,136 issued to J. C. Kent on June 15, 1993. These patents are incorporated herein by reference as to any teaching that is pertinent to the present invention. Specifically, the '215, '655, '508, '514 and '957 patents teach various systems for energizing the resistive layer of each device. All of the cited patents, except the '773 patent, are assigned to Elographics, Inc., a predecessor to the assignee of the present invention.

As taught in the cited patents, and particularly '215 and '136, the spacing between the insulating islands can be chosen by specific relationships to discriminate between touch objects of differing size. For example, it is often desired to differentiate between the touch of a sharp stylus and a finger tip. In other applications, it may be discrimination

between a finger tip and a hand palm, for example. To prevent activation by a hand palm (or the edge of the hand) when it is desired to activate the touchscreen by an object of smaller size, a closer spacing of the insulating islands is utilized. Thus, the contact of the smaller-sized object is detected without activation by the larger object. However, when the touchscreen is to be utilized for writing or similar applications, in addition to "point and shoot" operation that might reasonably be accomplished entirely with a finger tip, the close spacing causes problems as the writing instrument encounters several positions of the insulating islands. Accordingly, this disadvantage of writing upon touchscreens having closely spaced insulative islands must be tolerated or a compromise between partial discrimination and substantially uninterrupted writing is chosen.

Accordingly, it is one object of the present invention to provide a resistive touchscreen wherein relatively widely spaced insulative separate islands can be utilized for enhanced writing capabilities while retaining a discrimination against objects

having a size greater than that used for the writing - specifically against larger objects such as the palm of a writer using the touchscreen.

5 Another object of the present invention is to provide a resistive touchscreen therein a conductive layer overlaying a resistive layer is divided into discrete regions while retaining a desired sensitivity at any position
10 on the touchscreen.

 A further object of the present invention is to provide a resistive touchscreen wherein a conductive layer overlaying a resistive layer is divided into discrete regions, with each
15 discrete region being selectively connected into detection equipment so that regions where no response is desired can be isolated while leaving the remainder of the touchscreen operable for position determinations and/or an
20 annotation or drawing.

 These and other objects of the present invention will become apparent upon a consideration of the drawings referred to hereinafter and their complete description.

Summary of the Invention

In accordance with the present invention, there is provided a resistive touchscreen having multiple selectable sensitive regions for pressure discrimination. This is achieved in one embodiment by dividing a conductive cover sheet of a resistive touchscreen into electrically-isolated regions. In another embodiment which utilizes two resistive sheets, at least one of the resistive sheets is subdivided into isolatable regions. The entire touchscreens can be utilized as a single sensitive region, or at least one of the separate regions can be made sensitive and other regions made insensitive through the utilization of switching means. Thus, one or more regions can be made insensitive to provide palm rejection or other pressure discrimination when activation is desired only in the selected region of the touchscreen.

Brief Description of the Drawings

Figure 1 is an exploded view of a resistive touchscreen illustrating the present invention including a schematic diagram for its use.

Figure 2 is a plan view illustrating a coversheet of a touchscreen illustrated in Figure 1 for the present invention having a different embodiment than that illustrated in Figure 1.

Figure 3 is a plan view illustrating a coversheet of a touchscreen illustrated in Figure 1 for the present invention having a further embodiment.

Figures 4 and 4B are illustrations of a preferred form of resistor network/electrode configuration for introducing fields into a single layer of a resistor-type touchscreen of the type illustrated in Figure 1.

Figure 5 is an exploded view of another type of resistive touchscreen illustrating the present invention to provide discrimination.

Figure 6 is a plan view illustrating both layers of a resistive touchscreen as illustrated in Figure 5 employing the present invention providing regions of discrimination similar to that of Figure 2A.

Best Mode for Carrying out the Invention

Referring now to Figure 1, shown therein is an exploded view of one embodiment of a

10

device for accomplishing the above-stated objects. It will be recognized that the thickness (or height) of the components has been exaggerated for purposes of illustration.

5 A uniform resistive surface or layer 10 is applied to a suitable substrate 12. Of course if the resistive surface 10 has sufficient rigidity, no separate substrate 12 will be required. The substrate 12 may be, for
10 example, planar as shown. Further, the substrate 12 can be contoured as illustrated in U. S. Patent 4,220,815 so as to conform to the face of a curved object such as a conventional video display screen. The substrate 12 can
15 have any selected perimeter configuration, e.g., rectangular as shown, a configuration to match the configuration of a video display, etc.

 Orthogonal electrical fields are created
20 within the resistive layer 10 using a voltage source within the circuitry 14 and applying the voltage across the resistive layer in the two directions in separate time periods. This
 application of voltage is achieved through the
25 use of a resistor string or resistor element 16

to which a plurality of electrodes 18 are attached at selected intervals (see Figures 4 and 4A). Corner junctions 15 of the resistor-electrode array 16 are joined to the circuitry 14 by leads 17. Any one of several resistor-electrode combinations 16/18 can be utilized. Typical of such combinations are those of U. S. Patent Nos. 3,911,215, 4,661,655, 4,731,508, 4,797,514, and 4,822,957. In addition, potentials can be introduced into the resistive layer 10 by diode strings as is known in the art.

It is not necessary for purposes of the present invention that the fields be orthogonal. However, this is the most common type of resistor-type touchscreen.

Spaced above the resistive layer 10 is a conductive layer which, in accordance with the present invention has at least two conductive portions 20, 20A in this embodiment (see also Figures 2 and 3 for other typical embodiments). These two conductive portions are conventionally applied on the undersurface of an insulative cover layer 22. These portions are separated by a very narrow insulative band

24. Conductive portion 20 is connected to a switch means 26 by lead 28, and then to the circuitry 14 with lead 30. It will be understood that although the switch means 26 has been illustrated as a mechanical switch, any form of switching means can be utilized with the present invention.

As illustrated for this embodiment of Figure 1, the conductive portion 20 is always connected to the circuitry 14 through the switch means 26. Of course, it will be understood that this connection can be selected through a contact within the switch means 26 so as to disconnect portion 20 from the circuitry 14.

The conductive portion 20A is connected to a normally open contact of the switch means 26 by lead 32. With this connection, conductive portion 20A is only connected to the circuitry 14 when the switch means 26 is closed. The effect of this selective operation of switch means 26 will be discussed in detail hereinafter.

The conductive portions 20, 20A are separated from unintentional contact with the

resistive layer 10 using, for example, a
perimeter spacer 34. They are further
separated by spaced-apart small dots 36 of
insulative material. These dots or islands 36
5 are normally arranged in a uniform manner;
however, a non-uniform distribution is within
the scope of this invention. Further, the dots
36 can be arranged in a rectangular array, or
in a non-rectangular array as shown in U. S.
10 Patent 5,220,136. In the present invention the
maximum spacing between the dots 36 is governed
only by the need to prevent inadvertent contact
between the conductive layer portions 20, 20A
and the resistive layer 10. The dots 36 may be
15 applied to either the layer 10 or the
conductive layers 20, 20A, or to both surfaces.

Through the use of the multiplicity of
conductive layer portions 20, 20A (or other
combinations), some portions of the touchscreen
20 can be made "active" while other portions are
made "inactive" through operation of the switch
means 26. This will permit, for example, the
use of a stylus of some type as for writing on
one portion (e.g., 20) without the portion of
25 the hand holding the stylus (which rests on

portion 20A) registering at all on the
touchscreen. Since spacing of the dot
insulators 36 can be larger, because area
discrimination has been accomplished by the
5 separate portions, the dot insulators 36 do not
interfere with writing since fewer dot
insulators 36 are encountered. Of course, the
entire touchscreen can be made active by proper
operation of the switch means 26. As an
10 example, the operation of the switch may be
controlled by the use of a stylus "tethered" to
the system. When the stylus is placed in a
holder designed for that purpose, switch 26 is
closed and the entire screen is active. When
15 the stylus is removed, switch 26 is opened and
only region 20 of the touchscreen remains
active. This function is coordinated with the
rest of the system operation such that
appropriate indication of the use of only
20 region 20 is signaled when the stylus is
removed from the holder.

The configuration of the conductive
portions 20, 20A is not limited to that
illustrated in Figure 1. For example, they can
25 have a configuration as illustrated in Figure

2. Further, there is no restriction as to the number of separate conductive portions. This is illustrated in Figure 3 where there are three conductive portions 20, 20A, and 20B.

5 Thus any number of conductive portions of any configuration can be utilized within the scope of the present invention. Each would be connected (or disconnected) by an appropriate switch means 26 to the circuitry 14 so as to
10 select any one, any combination, or all of the portions of the touchscreen covered by the conductive portions to be made sensitive ("active") to a touch. Because the local resistivity of the conductive layer of the
15 touchscreen has negligible effect on the linearity of the touchscreen, the discrete nature of the conductive regions 20, 20A (or 20B, etc.) does not affect the linearity of the device as a whole. Generally the calibration
20 of the system is accomplished when all conductive portions are active; however, this may not be necessary depending on the specific locations of the conductive portions.

Although any of the known systems for
25 producing the orthogonal or position discriminating fields in the resistive layer

16

are useful for the present invention, a preferred system is that illustrated in Figures 4 and 4A (see U. F. Patent No. 4,731,508).

Some of the components are enlarged in order to properly distinguish them in these drawings.

In this embodiment, the resistive surface 10 extends substantially over the entire sensor.

A resistance member 16 around the perimeter of the resistive layer 10 is made up of four resistance element segments 38 (one along each edge of the perimeter, but only two shown) each consisting of a plurality of resistors. Where resistance element segments 38 join at corners 15 of the resistive layer 10, a connector 17 is provided for connection to the voltage in the circuitry 14.

Conductive electrodes 18 attached to the resistive layer 10 are positioned along each edge, with each electrode being joined to an adjacent resistance element with a conductive connector or lead 40. As discussed in the prior art (U. S. Patent Nos. 4,731,508 and 4,822,957) the spacing and effective lengths of the electrodes 18 are selected to produce a voltage gradient at each electrode to

compensate for any voltage drop that occurs along the resistance segments 38 perpendicular to current flow in the resistive layer 10.

5 A method of preventing undesirable current flow between the resistance segments 38 to the electrodes 18 is to form a line of discontinuity where there is no resistive coating between the resistance segments and the electrodes. As illustrated at 42 (see
10 particularly Figure 4A), this produces a central resistive area 10 and a peripheral resistive area 10A, preferably having the same resistivity. This can be accomplished by either not depositing any resistive coating
15 along that line 42 or removing the coating after application. In either case the leads 40 span the line 42 so as to connect the electrodes 18 with the resistive segments 38.

20 Within each of these resistance segments 38 there is a plurality of discontinuous units 44, with one such unit between each electrode lead 40. Each of these units 44 is formed by a pair of overlapping conductive legs, as at 46, 48. These legs overlap a length, L, and are
25 spaced apart a distance, D, (see Figure 4A).

The resistance produced for each unit 44 is a function of the spacing, D, the overlap length, L, and the resistance value of the resistive layer 10A. There is no critical location for the unit 44 between the electrodes 18 as long as the resistance value of each unit 44 is correct. Fine tuning of the resistance value of each unit 44 can be achieved by shortening or lengthening one or both of the legs 46, 48 to change the overlap length, L.

Assuming a touchscreen to be utilized for signature recognition, annotation, drawing or any other purpose which may require the user to input continuously varying positional data, the portion covered by conductive portion 20 (see Figure 1) is made active by the switch means 26. The operation of the switch means 26 also makes the conductive portion 20A inactive. Thus, writing or other input can proceed over portion 20 to obtain position information by the circuitry 14 without any input from portion 20A. Thus, the palm, the edge or the heel of the hand which rests on portion 20A provides no input to the circuitry 14, thus there is the desired discrimination. Of course, since if

one or more portion is not active, it will not respond to touch by an object of any size even as small as that in contact with the active portion. If the entire touchscreen is needed for position determination, the switch means 26 can be activated to a condition so that both conductive portions 20, 20A are connected to the circuitry 14.

It will be understood that similar operations can be achieved using a touchscreen having additional or differently shaped conductive portions, as in Figures 2 and 3. Obviously, the invention is not limited to just two or three conductive portions.

Another conventional type of resistive touchscreen to which the present invention is applicable is illustrated in the exploded view of Figure 5. This type of touchscreen utilizes a pair of confronting resistive layers 50, 52. The layers 50, 52 are typically separated by dot separators (not shown). Electrical potentials are applied to layer 50 with edge electrodes 54, 54A. Layer 52 is divided into two portions 52A and 52B by an insulating line 56 in a manner similar to that illustrated in

Figures 1-3. Accordingly, electrical potentials are applied to layer 52 through edge electrodes 58, 58A, 58B, and 58C.

As discussed below, layer 50 can similarly
5 divided into separate portions (see Figure 6).
As will be known by persons skilled in the art,
the various edge electrodes are connected to
circuitry (not shown but of the type utilized
for the embodiment of Figure 1) whereby the
10 appropriate voltages are fed to the electrodes
to provide the electrical potentials in proper
orientation and timed sequence. In a manner
similar to that utilized for Figures 1-3, the
separate resistive layer portions 52A and 52B
15 are connected to linked switches shown in
Figure 5 to cause the portions to be active or
inactive to achieve any desired touch
discrimination. It will be understood that the
resistive layer 52 can be divided into a
20 greater number of portions, also.

Referring to Figure 6, this is a plan view
illustrating how the two resistive layers 50,
52 can each be divided. The under resistive
layer 52 is illustrated as being oriented
25 orthogonally with its illustration in Figure 5.

Thus, the insulative line 56 is across the figure to produce the two portions 52A, 52B. The upper resistive layer 50 is divided by an insulative line 60 into the two portions 50A, 50B. The edge electrodes of each layer 50, 52 are connected to the circuitry and switch means (not shown) for providing voltages to the electrodes in a desired timed sequence, and for selecting active and inactive portions of the total touchscreen. Both layers 50, 52 can be separated into any selected number of portions to provide a desired position discrimination.

From the foregoing, it will be understood by persons skilled in the art that improved touchscreens have been developed that permit discrimination between contact by different objects of any size in different portions. This is achieved by subdividing at least one of the contacting sheets into a selected plurality of portions, each portion connected to a switch means so as to be "activated" or "inactivated" for providing inputs to a circuitry for determining touch position on the touchscreen. Thus, the present invention is not another class of the touchscreen/switch combinations

described in the prior art. Rather, it is a whole new category of touchscreens.

Although specific embodiments have been described for use of the present invention, this is not for the purpose of limiting the invention. Rather, the invention is to be limited only by the appended claims and their equivalents.

Claims**I CLAIM:**

1. A resistive position touchscreen for providing information as to a point of touch by an object, and selectively discriminating against contact of other objects, said
5 touchscreen comprising:

first and second closely spaced and separated sheets, said sheets contacting each other at a point when touched by an object at that point, at least one of said sheets divided
10 into a plurality of electrically separated regions;

a resistive layer applied to at least one of said first and second sheets on a surface facing another of said sheets, said resistive
15 layer having a selected substantially uniform resistivity throughout said layer;

field generating means connected to opposite edges of said resistive layer for
producing electrical fields in said resistive
20 layer;

a circuit means for applying voltages in proper timed sequence to said field generating means, and for receiving and analyzing signals

25 from said plurality of separated regions to
ascertain information as to a point of touch;
and

30 a switch means connected to each of said
separated regions to selectively connect at
least one of said separated regions with said
circuit means whereby a selected portion of
said resistive layer is active for providing
information as to the position of touch of the
object.

2. The touchscreen of Claim 1 wherein a
resistive layer is applied to confronting
surfaces of both said first and second sheets,
each said resistive layer having a
5 substantially uniform resistivity throughout;
and

wherein said field generating means is
connected to opposite edges of said resistive
layer on said first sheet and to opposite edges
of said resistive layer on said second sheet to
effectively provide intersecting electrical
fields in said touchscreen in a selected
alternating timed sequence.

5 3. The touchscreen of Claim 1 wherein
said resistive layer is applied to said first
sheet, said second sheet having a conductive
layer confronting said resistive layer, said
conductive layer being divided into said
plurality of electrically separated regions;
and

 wherein said field generating means is
connected to both opposite edges of said
resistive layer to provide within said
resistive layer alternating intersecting
electrical fields in a selected time sequence.

 4. The touchscreen of Claim 2 wherein
one of said resistive layers is divided into
said plurality of electrically separated
regions.

 5. The touchscreen of Claim 2 wherein
said resistive layers of said first and second
sheets are each divided into said plurality of
electrically separated regions.

 6. A resistive touchscreen for providing
information as to a point of touch by an
object, and selectively discriminating against

contact of other objects, said touchscreen
5 comprising:

a resistive layer having a selected
substantially uniform resistivity throughout
said layer, said resistive layer defining
perimeter edges;

10 field generating means connected proximate
said perimeter edges of said resistive layer
for producing intersecting electrical fields in
said resistive layer;

a conductive layer overlaying and
15 uniformly spaced from said resistive layer for
contacting said resistive layer when touched by
the object, said conductive layer divided into
a plurality of electrically separated
conductive regions;

20 a circuit means for applying voltages in
proper timed sequence to said field generating
means, and for receiving and analyzing signals
from said plurality of conductive regions to
ascertain the information as to the point of
25 touch; and

a switch means connected to each of said
conductive regions to selectively connect at
least one of said conductive regions with said
circuit means whereby a portion of said

resistive layer associated with said connected conductive region is active for providing information at said circuit means as to the position of a touch of the object to said connected conductive region, and whereby portions of said resistive layer associated with conductive regions not attached by said switch means to said circuit means are inactive as to providing position information.

7. The resistive touchscreen of Claim 6 further comprising insulator means for preventing inadvertent contact between said conductive layer and said resistive layer.

8. The resistive touchscreen of Claim 7 wherein said insulator means is a plurality of substantially uniformly distributed insulator islands positioned between said conductive regions and said resistive layer, said insulator islands having a height sufficient to prevent said inadvertent contact, and allow contact when said conductive layer is touched by the object.

9. The resistive touchscreen of Claim 6 wherein said resistive layer is supported by a substrate layer.

10. The resistive touchscreen of Claim 6 wherein said field generating means comprises:

5 a resistance element positioned proximate each of said perimeter edges of said resistive layer, each of said resistance elements having opposite ends joined to proximate ends of adjoining resistance elements, each of said resistance elements comprising a plurality of discontinuous units in electrical contact with
10 said resistive layer, each of said units formed by at least one line of conductive material spaced from a line of conductive material of an adjacent unit do define a separation gap of a selected width and length whereby said width
15 and length of said gap and said resistivity of said resistive layer establish a unit resistance for said units;

connection elements at said joined ends of said resistive elements connected to said
20 circuit means for applying voltage to said joined ends; and

a plurality of electrodes positioned on, and electrically connected to, said resistive layer along a preselected symmetrical path proximate each perimeter edge of said resistive layer, said electrodes each being connected to selected positions along said resistance elements to introduce said orthogonal electric fields in said resistive layer, said electrodes having a selected spacing and each electrode having an effective length along said path to produce a selected voltage gradient at each of said electrodes to compensate for any cumulative voltage drop along said resistance element perpendicular to current flow through said resistive layer during operation of said touchscreen when said orthogonal fields are introduced into said resistive layer.

11. A resistive touchscreen for providing information as to a point of touch by an object, and selectively discriminating against contact of other objects, said touchscreen comprising:

5

a substrate;

a resistive coating applied to a surface of said substrate, said coating having a

10 selected substantially uniform resistivity
throughout said layer, said resistive coating
defining perimeter edges;

field generating means connected proximate
said perimeter edges of said resistive coating
for producing orthogonal electrical fields in
15 said resistive coating;

a conductive layer overlaying and
uniformly spaced from said resistive coating
for contacting said resistive coating when
touched by the object, said conductive layer
20 divided into a plurality of electrically
separated conductive regions;

insulator means for preventing inadvertent
contact between said conductive layer and said
resistive coating;

25 a circuit means for applying voltages in
proper time sequence to said field generating
means, and for receiving and analyzing signals
from said plurality of conductive regions to
ascertain the information as to the point of
30 touch; and

a switch means connected to each of said
conductive regions to selectively connect at
least one of said conductive regions with said
circuit means whereby a portion of said

35 resistive coating associated with said
connected conductive region is active for
providing information at said circuit means as
to the position of a touch of the object to
said connected conductive region, and whereby
40 portions of said resistive coating associated
with conductive regions not attached by said
switch means to said circuit means are inactive
as to providing position information.

12. The resistive touchscreen of Claim 11
wherein said field generating means comprises:
a resistance element positioned proximate
each of said perimeter edges of said resistive
5 layer, each of said resistance elements having
opposite ends joined to proximate ends of
adjoining resistance elements, each of said
resistance elements comprising a plurality of
discontinuous units in electrical contact with
10 said resistive layer, each of said units formed
by at least one line of conductive material
spaced from a line of conductive material of an
adjacent unit do define a separation gap of a
selected width and length whereby said width
15 and length of said gap and said resistivity of

said resistive layer establish a unit resistance for said units;

connection elements at said joined ends of said resistive elements connected to said circuit means for applying voltage to said joined ends; and

a plurality of electrodes positioned on, and electrically connected to, said resistive layer along a preselected symmetrical path proximate each perimeter edge of said resistive layer, said electrodes each being connected to selected positions along said resistance elements to introduce said orthogonal electric fields in said resistive layer, said electrodes having a selected spacing and each electrode having an effective length along said path to produce a selected voltage gradient at each of said electrodes to compensate for any cumulative voltage drop along said resistance element perpendicular to current flow through said resistive layer during operation of said touchscreen when said orthogonal fields are introduced into said resistive layer.

13. A resistive touchscreen for providing information as to loci of points along a line

of touch by a hand-held object, and selectively discriminating against contact of other objects, said touchscreen comprising:

a substrate;

a resistive coating applied to a surface of said substrate, said coating having a selected substantially uniform resistivity throughout said coating, said resistive coating defining perimeter edges;

field generating means connected proximate said perimeter edges of said resistive coating for producing orthogonal electrical fields in said resistive coating;

a conductive layer overlaying and uniformly spaced from said resistive coating for contacting said resistive coating when touched by the object, said conductive layer divided into a plurality of electrically separated conductive regions, at least one of said regions for receiving the line of touch by the hand-held object and at least one region for supporting the hand;

insulator means for preventing inadvertent contact between said conductive regions and said resistive coating;

34

30 a circuit means for applying voltages in proper time sequence to said field generating means, and for receiving and analyzing signals from said plurality of conductive regions to ascertain the information as to the loci of points of the touch; and

35 a switch means connected to each of said conductive regions to selectively connect at least one of said conductive regions with said circuit means whereby a portion of said resistive coating associated with said connected conductive region is active for
40 providing information at said circuit means as to the loci of points of the touch of the object to said connected conductive region, and whereby portions of said resistive coating associated with conductive regions not attached
45 by said switch means to said circuit means are inactive as to providing position information to discriminate against touch of the hand.

14. The resistive touchscreen of Claim 13 further comprising insulator means for preventing inadvertent contact between said conductive layer and said resistive coating.

15. The resistive touchscreen of Claim 14 wherein said insulator means is a plurality of substantially uniformly distributed insulator islands positioned between said conductive regions and said resistive coating, said insulator islands having a height sufficient to prevent said inadvertent contact, and allow contact when said conductive layer is touched by the object.

16. The resistive touchscreen of Claim 13 wherein said field generating means comprises:

a resistance element positioned proximate each of said perimeter edges of said resistive layer, each of said resistance elements having opposite ends joined to proximate ends of adjoining resistance elements, each of said resistance elements comprising a plurality of discontinuous units in electrical contact with said resistive layer, each of said units formed by at least one line of conductive material spaced from a line of conductive material of an adjacent unit do define a separation gap of a selected width and length whereby said width and length of said gap and said resistivity of

said resistive layer establish a unit resistance for said units;

20 connection elements at said joined ends of said resistive elements connected to said circuit means for applying voltage to said joined ends; and

25 a plurality of electrodes positioned on, and electrically connected to, said resistive layer along a preselected symmetrical path proximate each perimeter edge of said resistive layer, said electrodes each being connected to selected positions along said resistance elements to introduce said orthogonal electric fields in said resistive layer, said electrodes
30 having a selected spacing and each electrode having an effective length along said path to produce a selected voltage gradient at each of said electrodes to compensate for any cumulative voltage drop along said resistance
35 element perpendicular to current flow through said resistive layer during operation of said touchscreen when said orthogonal fields are introduced into said resistive layer.

17. A resistive touchscreen for providing information as to a point of touch by an

object, and selectively discriminating against
contact of other objects, said touchscreen
5 comprising:

a first resistive layer having a selected
substantially uniform resistivity throughout
said layer, said first resistive layer defining
perimeter edges;

10 a second resistive layer closely spaced
from said first resistive layer, said second
resistive layer having a selected substantially
uniform resistivity throughout said second
layer of a value corresponding to said
15 resistivity of said first resistive layer, said
second resistive layer defining perimeter
edges, at least one of said first and second
resistive layers divided into a plurality of
electrically separated regions;

20 electrical field generating means
connected proximate opposite of said perimeter
edges of said first and second resistive layers
for producing intersecting electrical fields in
said touchscreen in alternating timed sequence

25 a circuit means for applying voltages in
proper timed sequence to said field generating
means, and for receiving and analyzing signals
from said plurality of separated regions to

ascertain the information as to the point of
30 touch; and

a switch means connected to each of said
separated regions to selectively connect at
least one of said separated regions with said
circuit means whereby a portion of said one of
35 said resistive layers associated with said
connected separated region is active for
providing information at said circuit means as
to the position of a touch of the object to
said connected separated region, and whereby
40 portions of said resistive layer associated
with separated regions not attached by said
switch means to said circuit means are inactive
as to providing position information.

18. The resistive touchscreen of Claim 16
wherein said first and second resistive layers
are separated with a plurality of substantially
uniformly distributed insulator islands, said
5 insulator islands having a height sufficient to
prevent inadvertent contact between said
resistive layers, and allow contact when one of
said resistive layers is touched by the object.

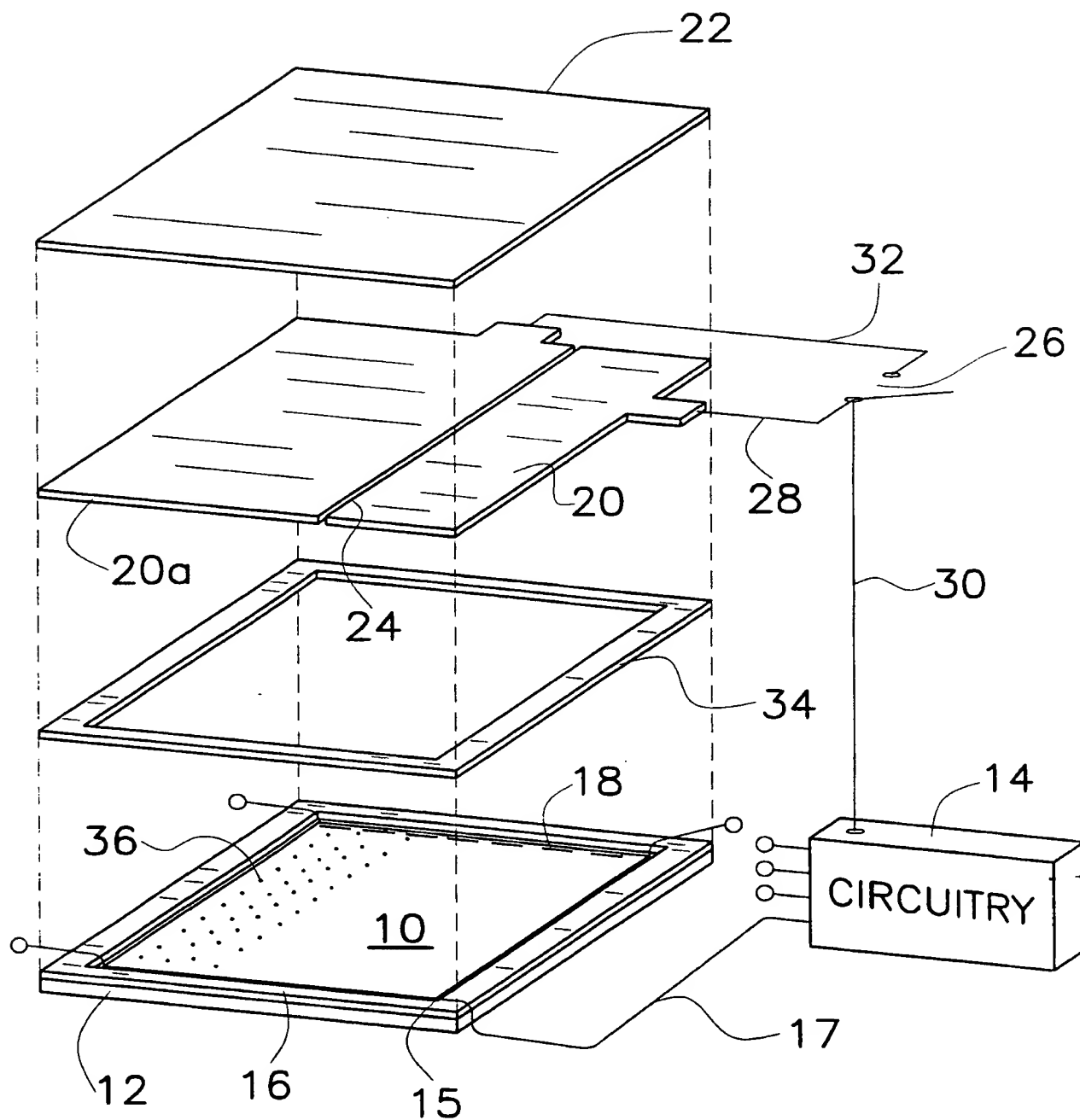
19. The resistive touchscreen of Claim 16 wherein said field generating means comprises:

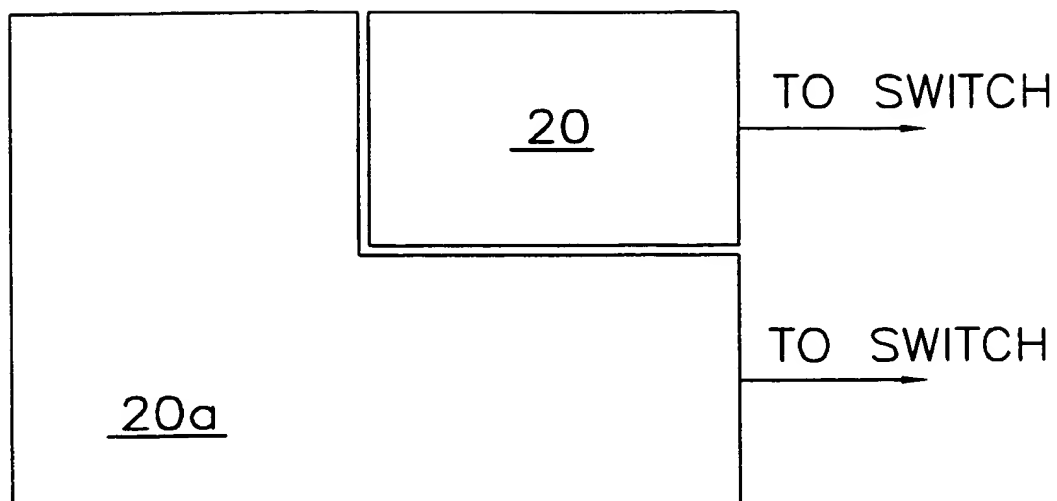
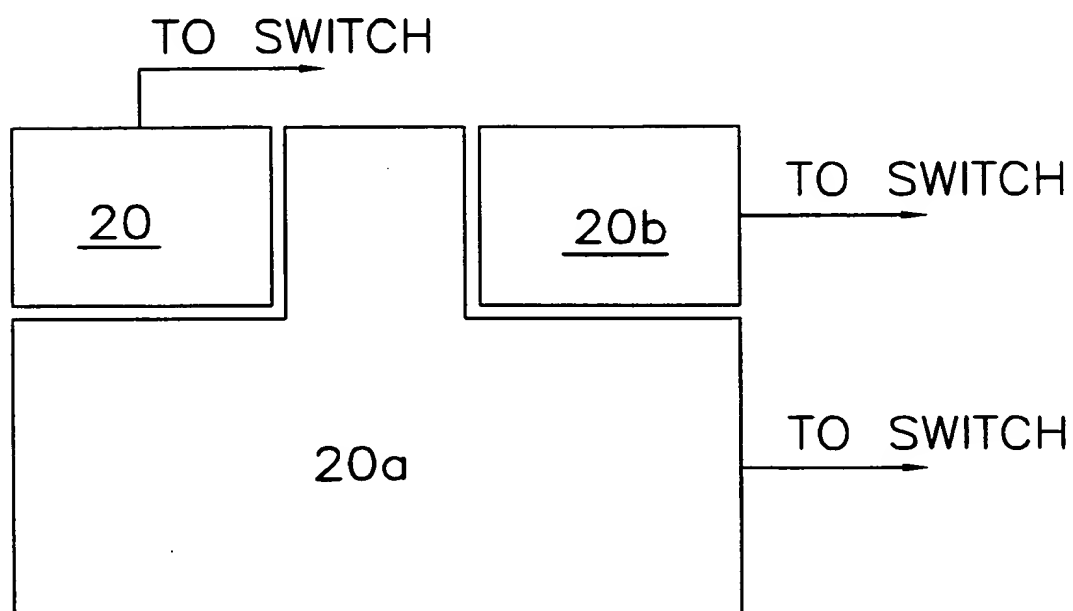
a first pair of electrodes in electrical contact with said first resistive layer at
5 opposite of said perimeter edges;

a second pair of electrodes in electrical contact with said second resistive layer at opposite of said perimeter edges, said second pair of electrodes being orthogonally arranged
10 with respect to said first pair of electrodes;
and

connections from said first and second pair of electrodes to said circuit means to receive voltages in a selected timed sequence
15 to produce electrical fields in said first and second resistor layers that are intersecting with respect to each other.

20. The touchscreen of Claim 17 wherein both of said resistive layers are divided into a plurality of electrically separated regions, electrodes of each said separated regions
5 connected to said circuit means.

**Fig.1**

**Fig.2****Fig.3**

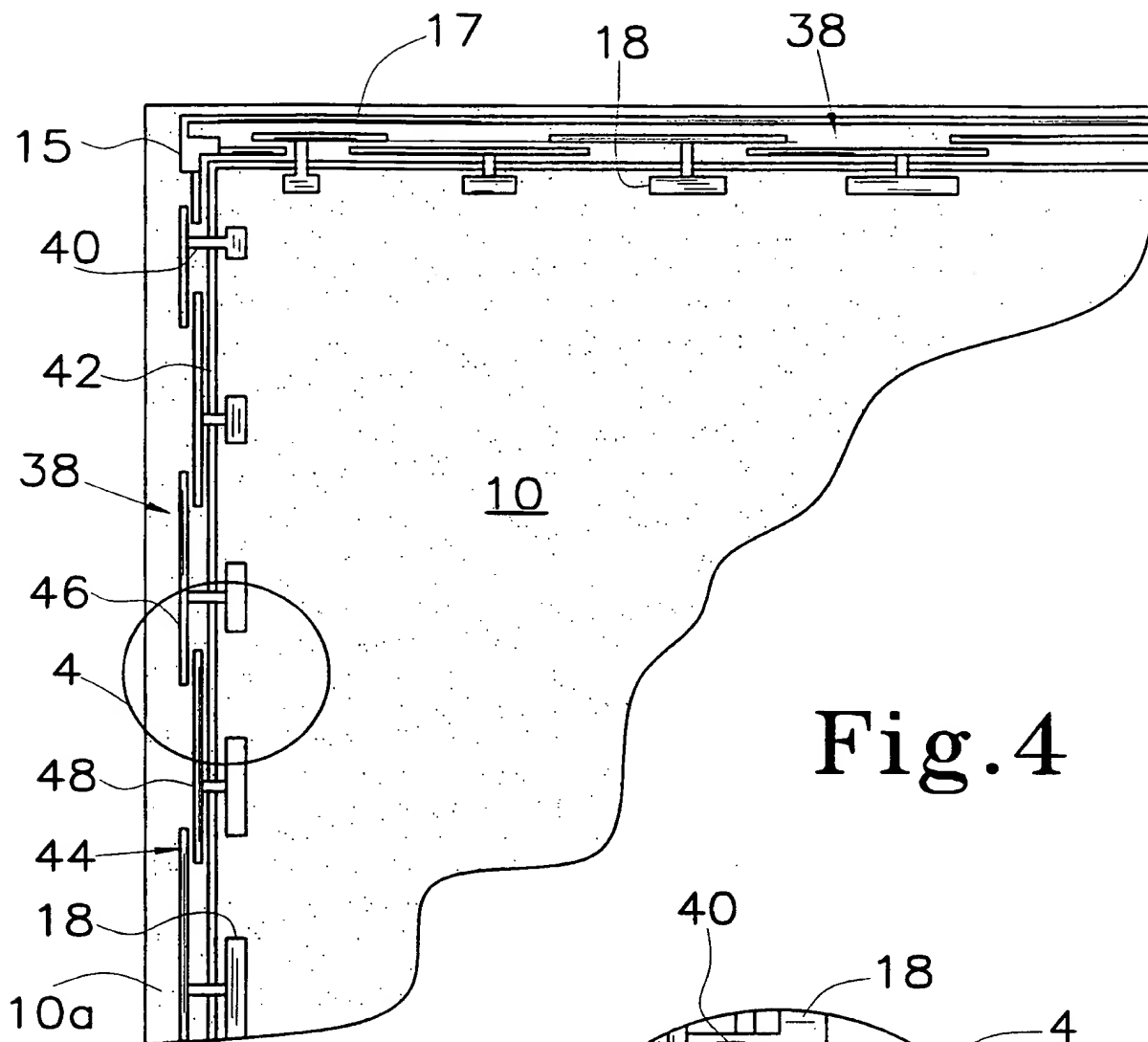


Fig. 4

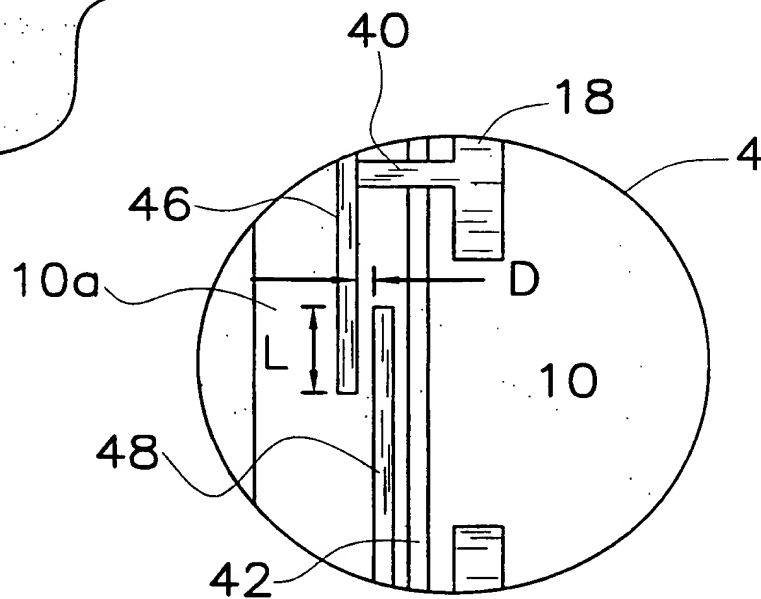


Fig. 4a

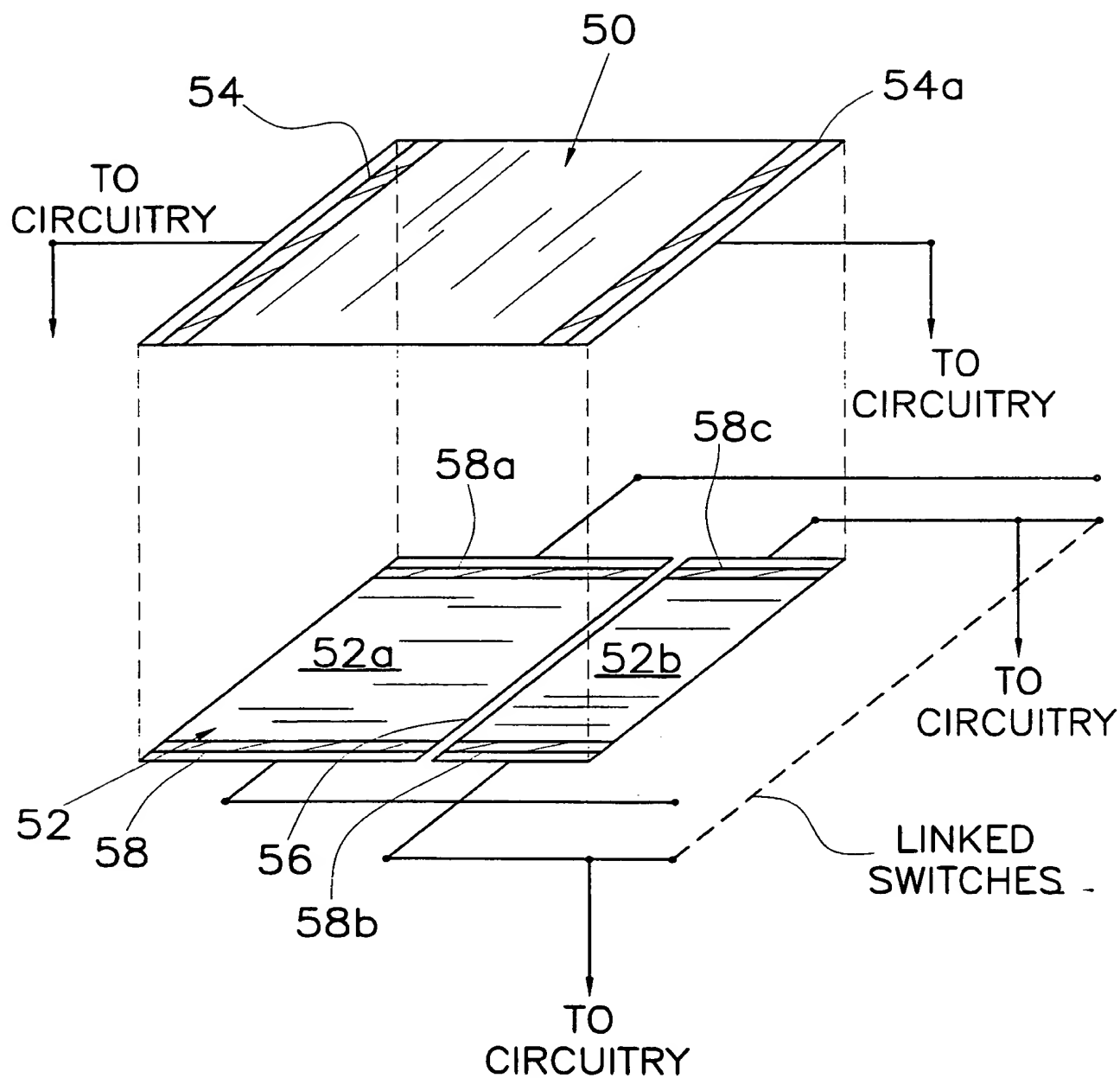
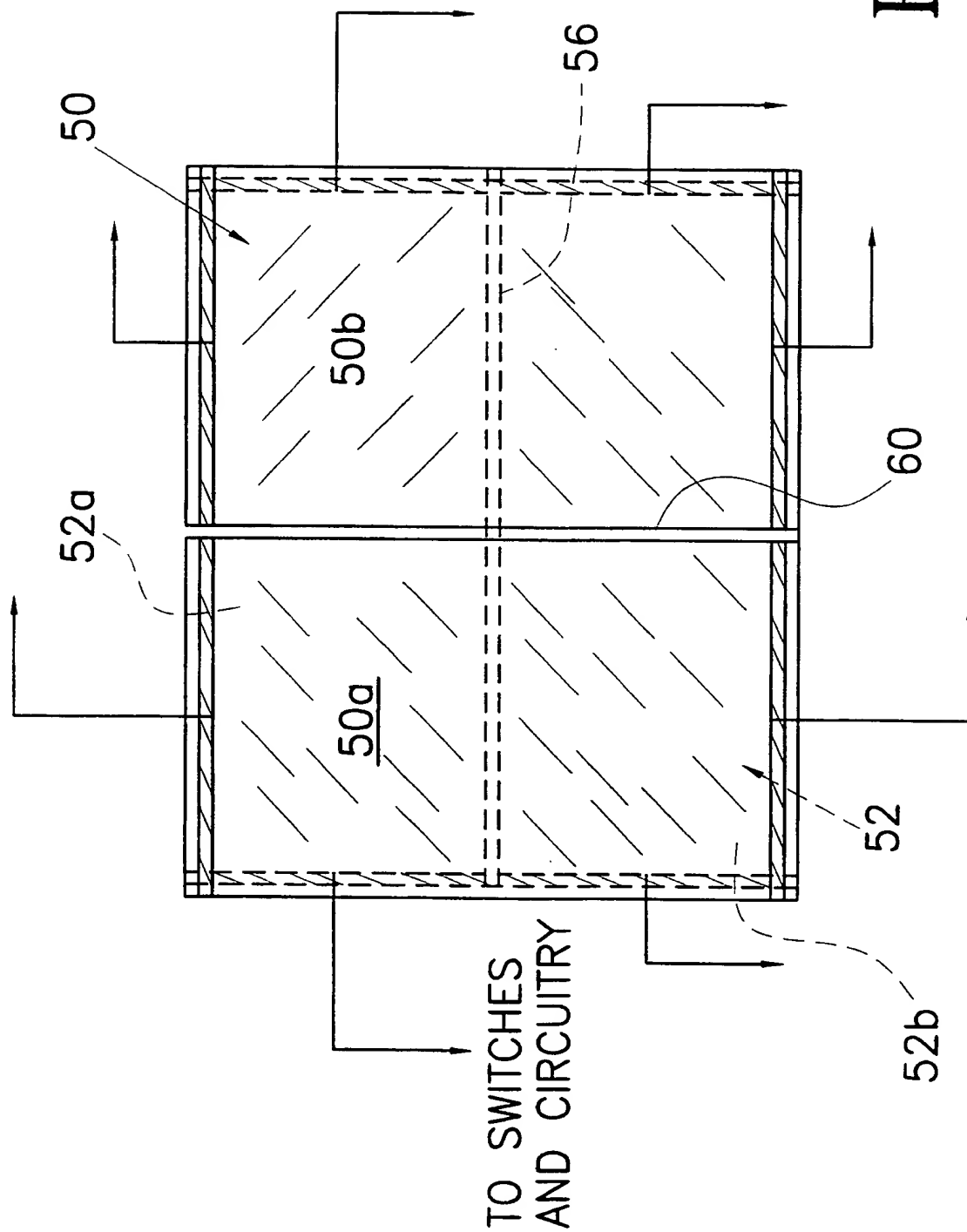


Fig.5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/18755**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : G08C 21/00; G09G 3/02

US CL : 178/18,19,20; 345/173,174

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 178/18,19,20; 345/173,174

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,822,957 A (TALMAGE, Jr. et al) 18 April 1989, figures 1,6,6A; col.3,line 58-col.4,line 48; col. 10, line 33-60.	1-20
A	US 5,157,227 A (McDERMOTT et al) 20 October 1992, figures 3-5; columns 5-6	1-20
A	US 5,220,136 A (KENT) 15 June 1993, figures 2-5; columns 5-6.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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A

document member of the same patent family

Date of the actual completion of the international search

08 DECEMBER 1997

Date of mailing of the international search report

24 FEB 1998

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